

5<sup>th</sup> Workshop on Atmospheric Science from Space  
using Fourier Transform Spectrometry

**CROSS WITH YOUR SPECTRA?  
CROSS-CORRELATE INSTEAD!**

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The use of cross-correlation for certain types of spectral analysis is discussed.

**Outline**

Under certain circumstances, the use of cross-correlation between a real spectrum and either a model or another real spectrum can provide a very powerful tool for spectral analysis. Furthermore it can be used either qualitatively (i.e., for identification) or quantitatively. It can be quantitative because when the real spectrum and the model become close, cross-correlation (except for noise) approaches autocorrelation and it is well known that the peak of an autocorrelation is always greater than the cross-correlation of two dissimilar functions. The key is to find a function that describes the approach in a nearly linear fashion (the standard correlation function fails badly in this regard).

The method (and its limitations) will be described with concrete examples using ATMOS data.

An added benefit of the technique is that it provides an extremely accurate method of determining frequency shifts in spectra (e.g., Doppler shifts or calibration errors). With ATMOS data, accuracies of 1-2 meters per second are routinely achieved even in the face of orbital Doppler shifts of 6-7 *kilometers* per second. This corresponds to determining the position of the correlation peak to 1-2% of the point spacing. Several approaches to accomplishing this are available.